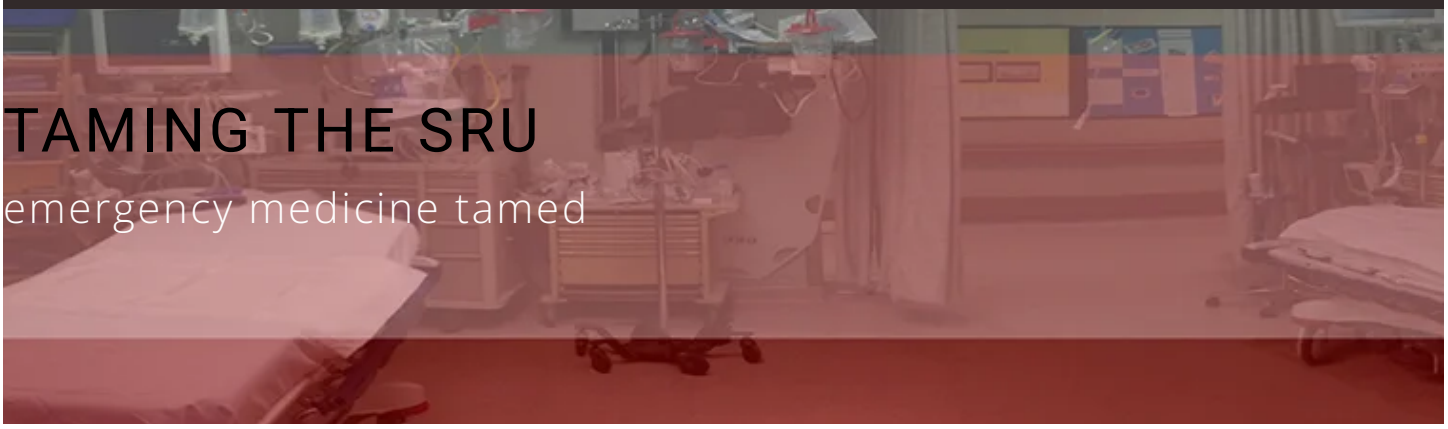

Is a Bag Enough?

September 18, 2019

"Effectiveness of Manual Ventilation in Intubated Helicopter Emergency Services—Transported Trauma Patients." Air Medical Journal, April 2019.

Introduction

Trauma scene flights are often the first thing people think of when they think of Helicopter EMS. Although we know that HEMS and Critical Care Transport involves much more than just scene flights, they are still a critical part of most HEMS programs' mission and capabilities. In addition, many flights are "modified scenes" or "scene intercepts," meaning the HEMS crew meets the EMS crew at an outlying hospital helipad, or arrives shortly after the patient's arrival to an under-resourced ED. Many of these patients are critically ill, and a subset will require intubation and ventilation.

Those patients who do require intubation and ventilation are critically ill, and often have hemodynamic compromise or intracranial injuries. As we are continuing to evolve our knowledge of resuscitation science and neuroprotection, it is becoming increasingly apparent that tight regulation of oxygenation and ventilation is critical for optimal outcomes for these patients.

Once intubated, patients can be either manually ventilated ("bagged") or

ABOUT US

SRU (PRONOUNCED "SHREW") = SHOCK RESUSCITATION UNIT

Training in, and managing, the SRU is one of the crown jewels of our residency. It is where the sickest of the sick patients are found in our ED. It is a crucible, a test of knowledge and strength, and a true manifestation of the tripartite mission of our department: Leadership, Excellence, and Opportunity.

bagging argue that its simplicity, ease of use, low cost, and reduced time to setup all make it the preferred method. Detractors argue that it is dependent on a human operator, which makes it much more variable and open to error due to distraction, cognitive overload, inconsistency, and requirement for attention and hands to be occupied at all times. Alternatively, oxygenation and ventilation using a mechanical ventilator can provide precise, automatic, consistent efforts, and frees up the clinicians to concentrate on and perform other tasks. The downside being the increased complexity, the time needed for setup, cost, as well as training necessary for ventilator use. In addition, many scene flights have short transport times, seemingly reducing the benefit of mechanical ventilation.

METHODS

This paper was a prospective, observational proof of concept study. They collected a convenience sample of data over 7 months in 2015. 20 patients who were intubated on scene and transported by the program using only manual ventilation were included. Their hypothesis was that manual ventilation would be sufficient to maintain a physiologic ETCO2. ETCO2 of 35-45 mm Hg was considered to be physiologic/normal for this study. Oxygen levels of > 90% were considered to be normal.

A total of 20 cases were enrolled. They were all blunt trauma patients and the majority were motor vehicle accidents. The majority of the patients had some component of head injury. The mean age was 39 years, with the majority being men. The primary outcome was ventilation, looking at the ETCO2 values. A secondary outcome was oxygenation.

RESULTS

As mentioned above, the primary outcome was the percentage of time (data points) spent in a physiologic ETCO2 range. They found that only 48.7% of the data points were within the goal ETCO2 range. The majority of the disparate end-points were hypocapnic, occurring twice as often as hypercapnia. In terms of oxygenation, 83.6% of the data points were within the goal oxygen range (> 90%). They did not examine patient outcomes or other significant end-points.

LIMITATIONS

This study is limited for several reasons. Due to being a pilot study, as well as a single center/program study, only 20 patients were enrolled. Many of the patients had similar mechanisms and similar pre-existing demographics

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were not recorded, and there were no control patients that were managed in an alternative way (for instance, with a mechanical ventilator). In addition, many of these patients had multiple organ systems injured, and so could have contributions to their vital sign abnormalities from primary respiratory injuries as well as poor perfusion from shock. In particular, the five most hemodynamically unstable patients accounted for most of the hypocapnic data points. This raises the distinct possibility that their state of shock and low cardiac output was a significant contributor to their low end-tidal capnography. Having said that, 80% of the patients did have a single datapoint under 25 mm Hg, indicating that there likely is a problem with hyperventilation regardless of patient hemodynamics.

DISCUSSION

The paper highlights several things I feel strongly about. Many of us feel that all intubated patients should ideally be managed with a mechanical ventilator. I believe this paper further supports that belief. Although they did not have a control group that was mechanically ventilated, I suspect that the rate of inadvertent hypo- or hyperventilation would be significantly less with consistent, automated ventilation, which is easy to precisely adjust.

The majority of these patients had some element of head injury. As we know from the EPIC-TBI studies from Arizona, patients with a Traumatic Brain Injury with a single episode of hypoxia are 3x more likely to die. 16% of the time, these patients were hypoxic. (2) Although there are many contributing factors (such as pneumothorax, pulmonary contusion, pre-existing comorbidities), I suspect this number likely would have been less with precise mechanical ventilation.

In addition, the clinicians here reported that they were primarily adjusting their bagging rate and perceived volume based upon the patient's oxygen levels, with control of pCO2 being the secondary concern. This led to many patients who were hypoxic also being very hypocapnic, as they were hyperventilated in hopes of increasing their oxygen levels. Unfortunately, we know that many of these hypoxic patients benefit more from increasing FiO2 and PEEP, rather than increasing the speed or depth of volume delivered. I do not know if they used PEEP valves.

Regardless, we know that tight control of patient's ventilation and pCO2 is critically important for ill patients. Both acidemia and alkalemia alter oxygen delivery to tissues, as well as the function of many metabolic processes. Of particular importance in these polytrauma patients are the deleterious effects on coagulation. In addition, patients with intracranial injuries need

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LINKS

Pressure: pCO2 can alter the flow of blood in and out of the brain, not only altering the Mean Arterial Pressure, but also the Intracranial Pressure. (CPP = MAP – ICP)

Another thing to consider are short flight times. This papers references flight times of as little as 8-10 minutes. However, I always urge people to be cautious when referencing “flight time.” I think it is much more pertinent to think of “transport time” or “out-of-hospital” time. Even with a scene that is only an 8 minute flight away, the total time that you are ventilating that patient is likely closer to 25-30 minutes when you consider loading, helicopter start-up, take-off, flight, landing, unloading, and transitioning down to the trauma bay with eventual hand-off to the trauma team and respiratory therapist there. Throughout all of this, one person has to be manually bagging and I do not feel they can properly do that and assist with all the other requisite activities.

Within our own program (University of Wisconsin Med Flight), we have found that the best way to increase usage of the ventilator is through a systems-based approach. We have recently switched to new ventilators, and have changed how we set-up and store our ventilator, which has made it significantly easier to quickly utilize in these time-critical situations. I would recommend other programs who wish to increase their ventilator compliance examine their systems first, and their education/individual compliance second.

I’m happy to hear any feedback. Thank you for reading and for your time.

As Andy Stumpf said – “what you allow in your presence is your standard.”

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AUTHORSHIP

Written by Andrew Cathers, MD - Dr. Cathers is an Emergency Medicine Physician as well as Flight Physician, and Assistant Medical Director of University of Wisconsin Med Flight with a focus on Education and Training in their Program. He is kind enough to share recaps of recently published HEMS literature which should be posted quarterly here on TamingtheSRU

Posted by Jeffery Hill, MD MEd

Jeffery Hill, MD M.Ed

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